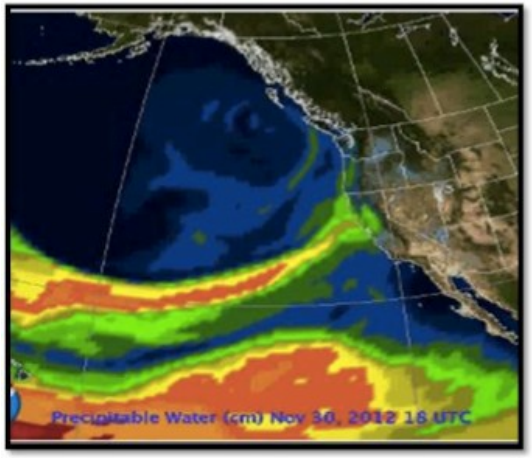
# Water Management Applications of Research Projects on Extreme Weather Events




**Sustainable Water Resources Roundtable**
**Healdsburg, CA**
**May 3, 2018**

**Jay Jasperse, Chief Engineer**
**Sonoma County Water Agency**

SONOMA COUNTY WATER AGENCY

# Overview

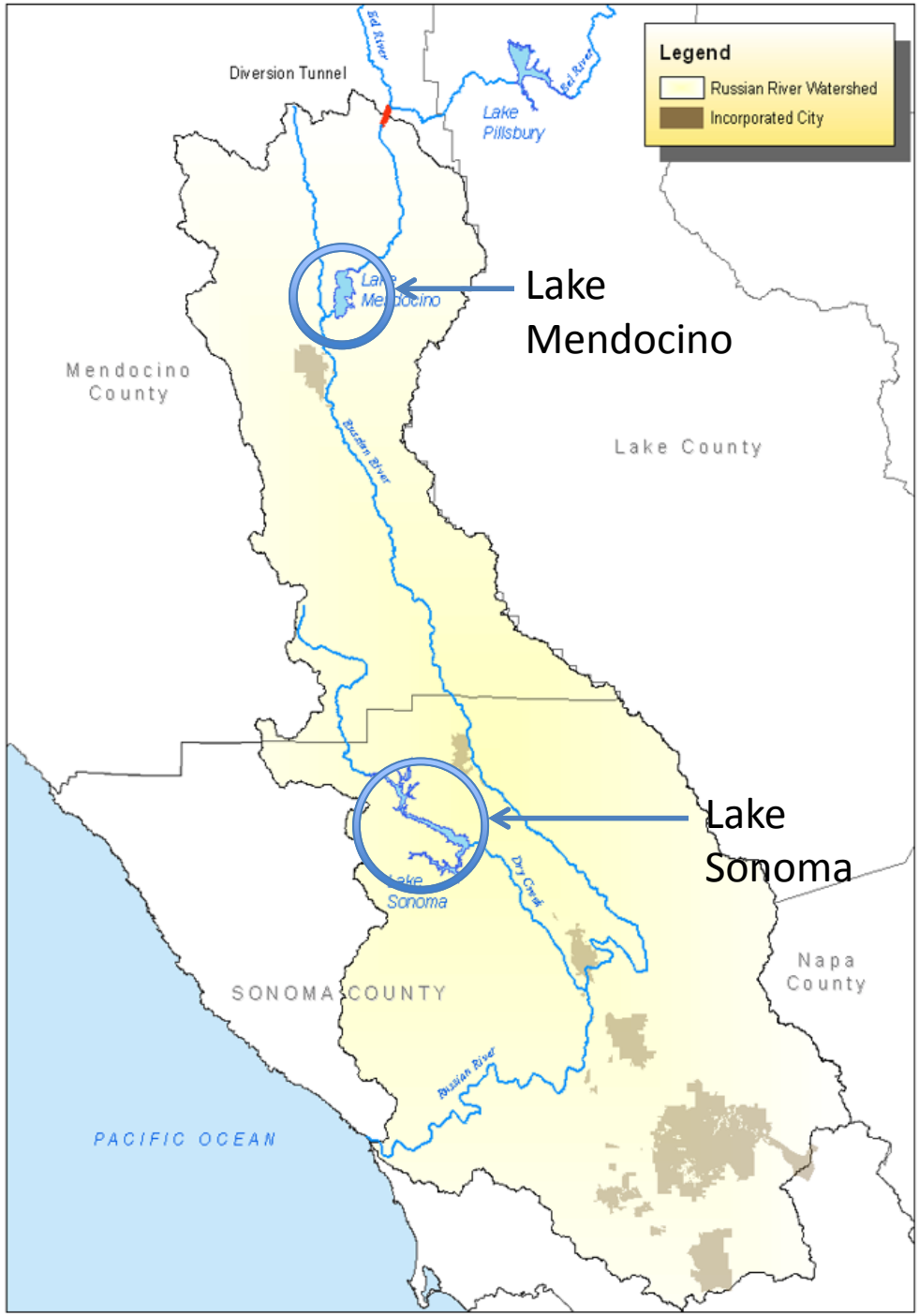
- Background – Regional Context
- Why Atmospheric Rivers Are Important in Water Resource Management
- Forecast Informed Reservoir Operations (FIRO)
- Wildfire Implications

## Sonoma Co. Water Agency

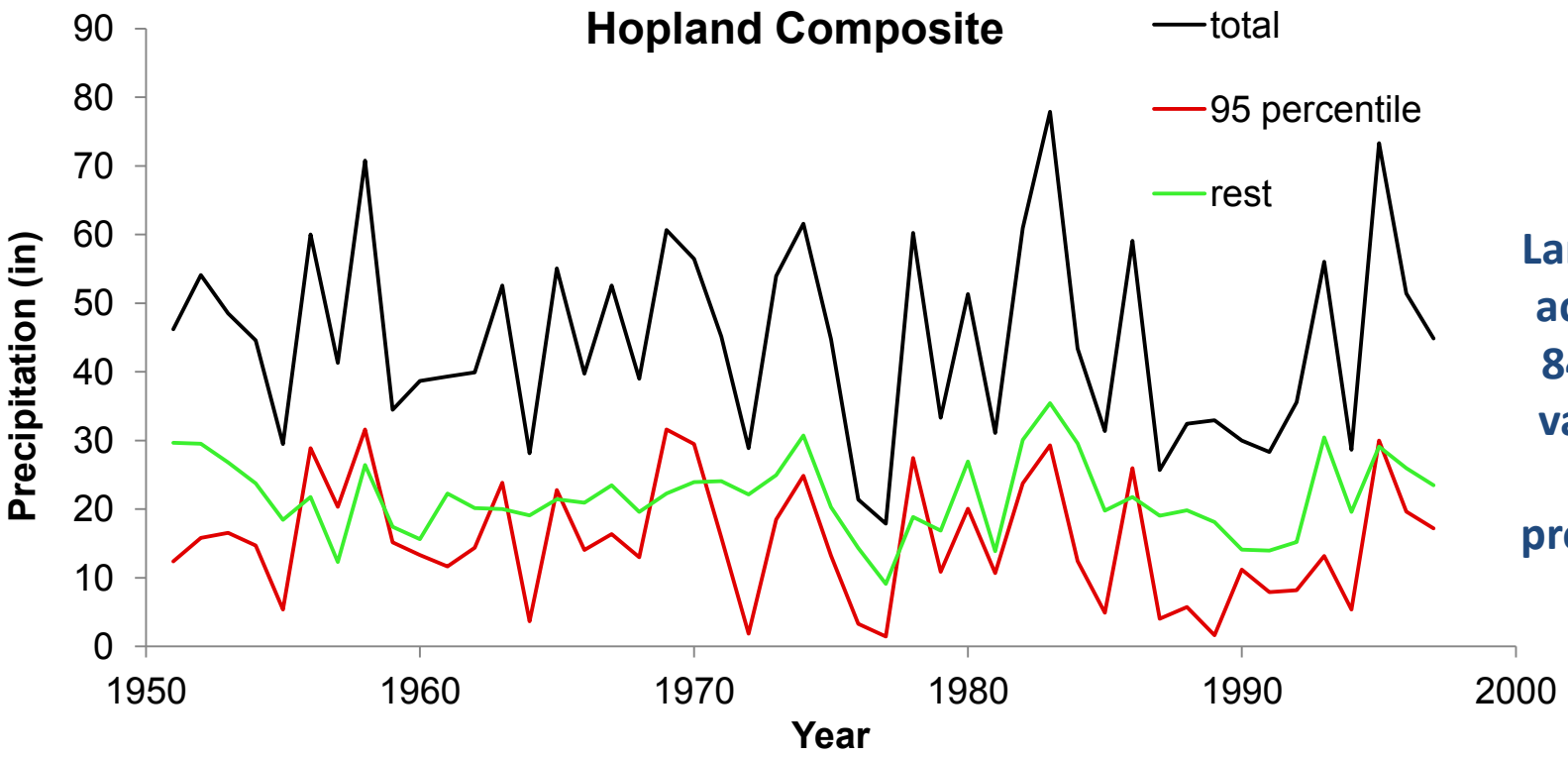
- Special Act District
- Regional Wholesale Water Supply
- Flood Management
- Sanitation

## Russian River Reservoirs Multi-Purpose Facilities

- Flood Management (ACOE)
- Water Supply (SCWA)
- Operations Dictated by Storage-Levels Relative to "Rule Curve"
- Must Provide for Water Supply, Flood Management, Ecosystem, Recreation & Agricultural Needs



# Atmospheric Rivers Drive Droughts & Floods



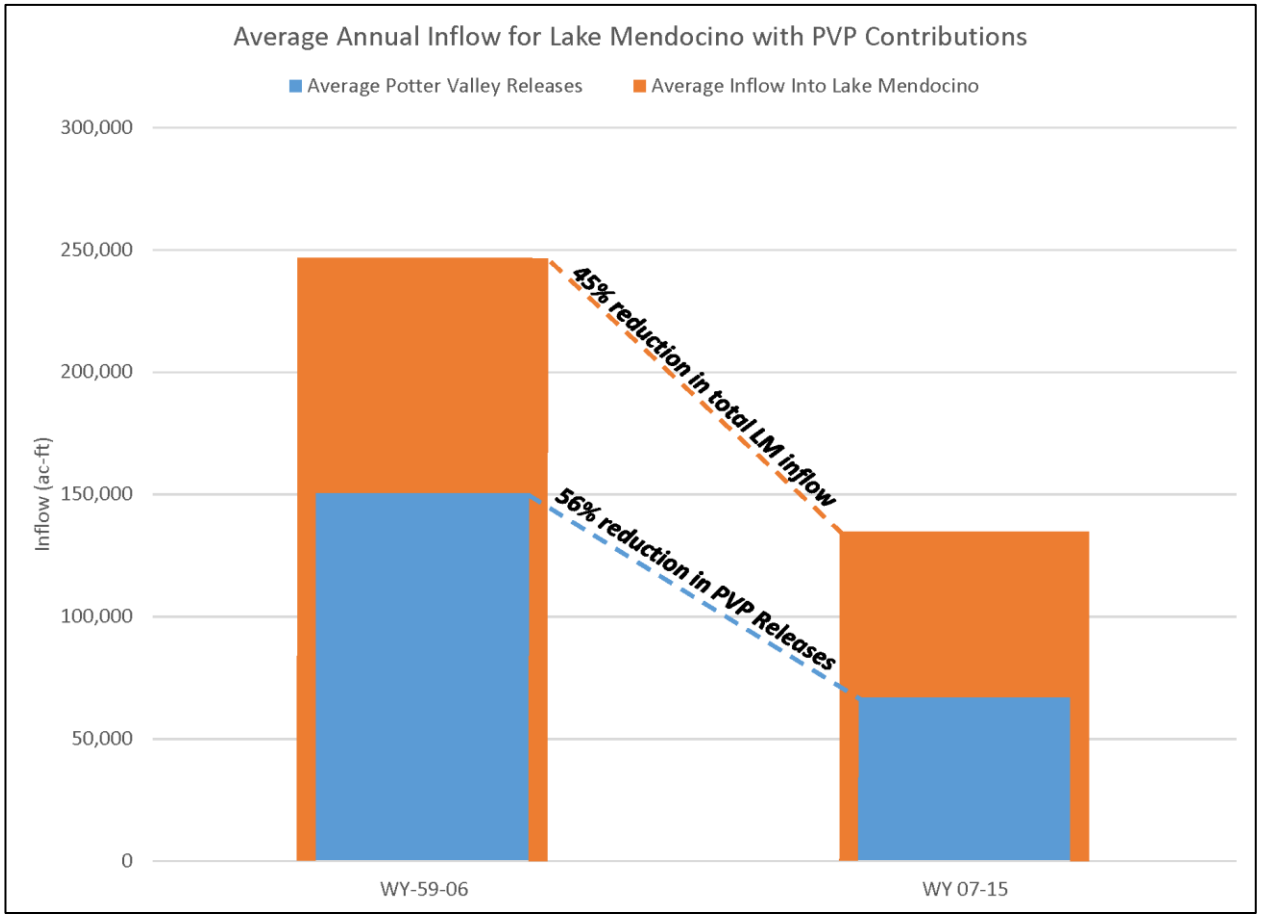

**Large storms account for 84% of the variance of total precipitation**

From M. Dettinger, USGS

# Coyote Valley Dam & Lake Mendocino

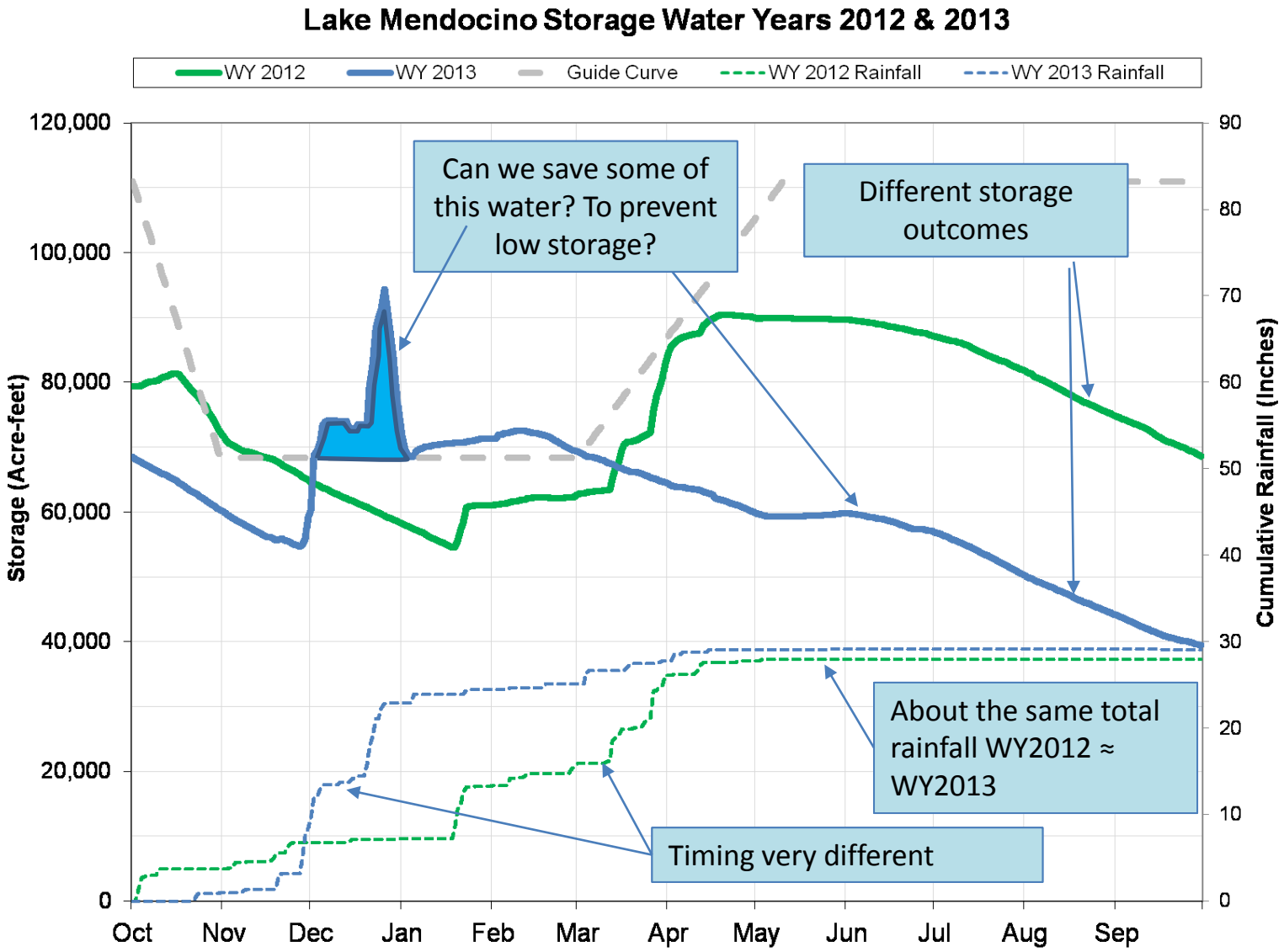
- **Upper Russian River Watershed**
- **Coyote Valley Dam**
  - Constructed by the Army Corps of Engineers in 1959
  - USACE: Flood Control
  - SCWA: Water supply
- **Watershed Area: 105 mi²**
- **Max Water Supply: 111,000 acre-feet**
- **Potter Valley Project – PG&E**
  - Imports water from the Eel River to the East Fork Russian River

# Reduced Potter Valley Inflows - Significant Impact to Lake Mendocino




- **2004 FERC License Amendment implemented in Fall 2006**
  - Significant reductions in Eel River imports through the PVP
  - Water supply reliability challenges in Lake Mendocino

# Lake Mendocino
# Forecast Informed Reservoir Operations



# Lake Mendocino FIRO Steering Committee – A Collaborative Effort

- **Co-Chairs**
  - Jay Jasperse – Sonoma County Water Agency
  - F. Martin Ralph – UCSD / SIO / CW3E
- **Members**
  - Michael Anderson – California DWR
  - Levi Brekke – USBR
  - Nick Malasavage – USACE / SPN
  - Michael Dettinger – USGS
  - Joe Forbis – USACE / SPK
  - Alan Haynes – NOAA / NWS
  - Patrick Rutten – NOAA / NMFS
  - Cary Talbot – USACE / ERDC
  - Robert Webb – NOAA / OAR

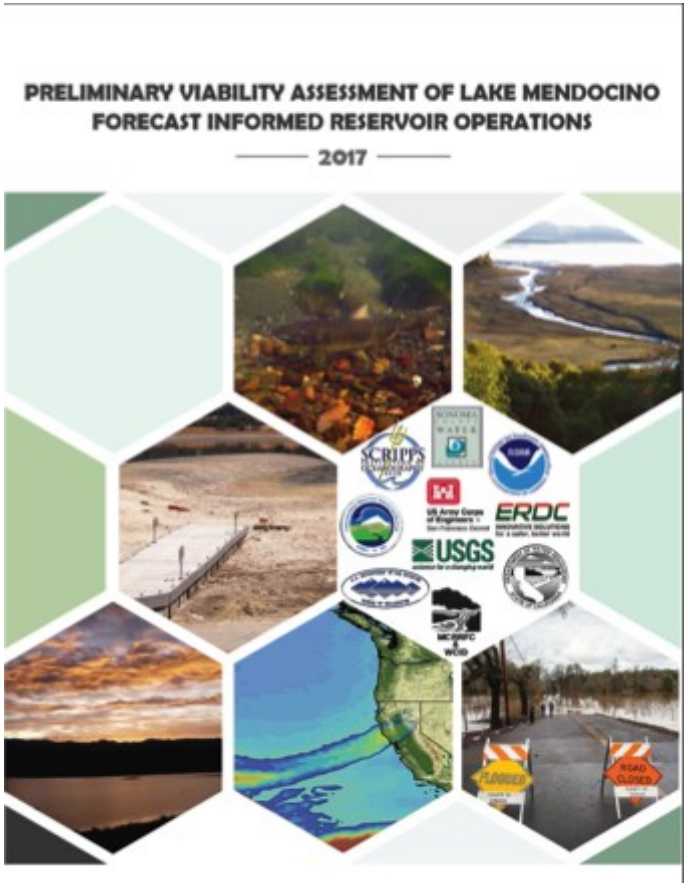
## Project Partners

# Lake Mendocino FIRO
## Preliminary Viability Assessment - 2017

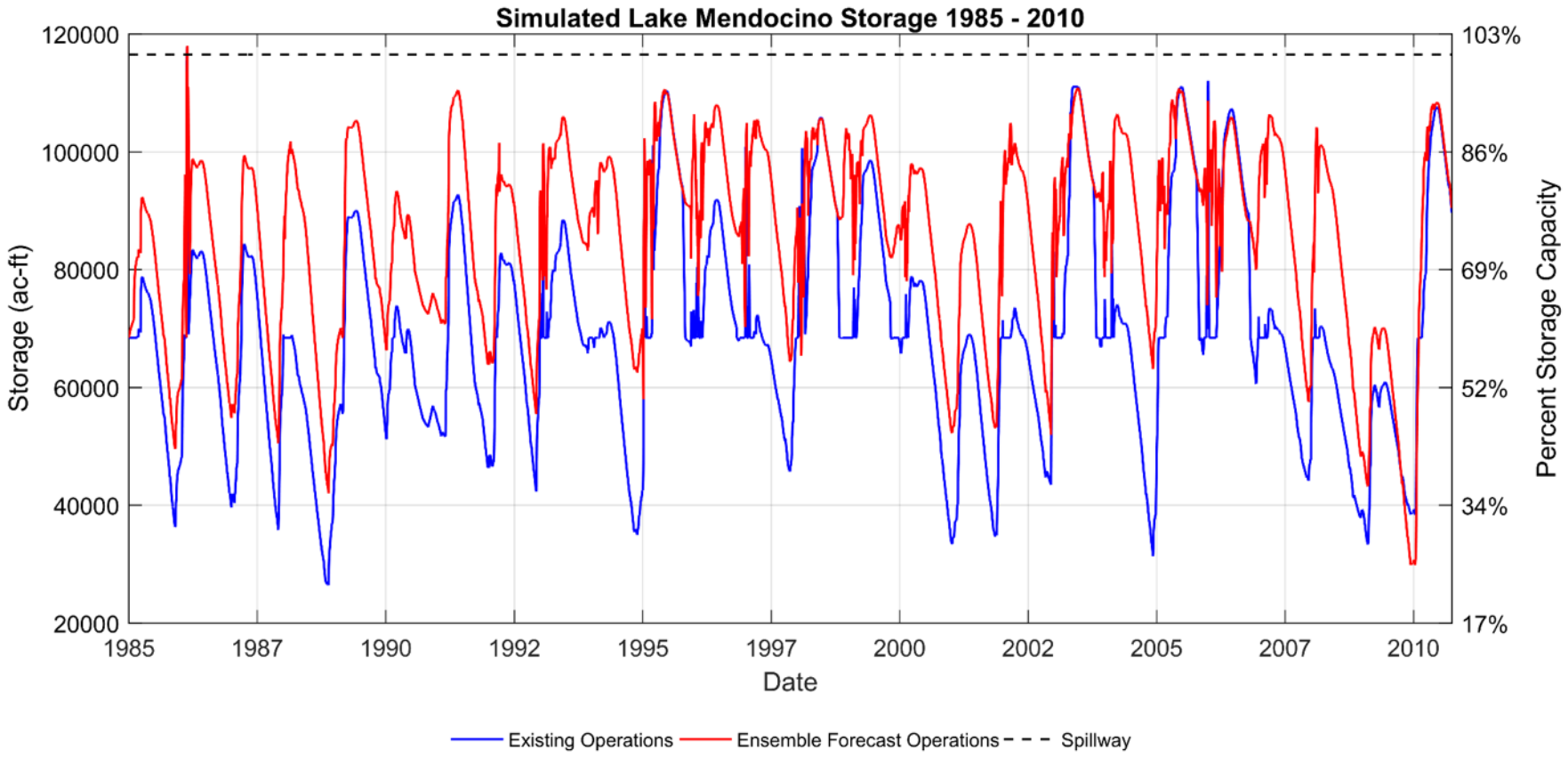
**SCWA** – Development and evaluation of a reservoir model that leverages streamflow forecast skill

**USACE HEC** – Evaluation of multiple reservoir management rule-sets/schemes in the HEC-WAT framework

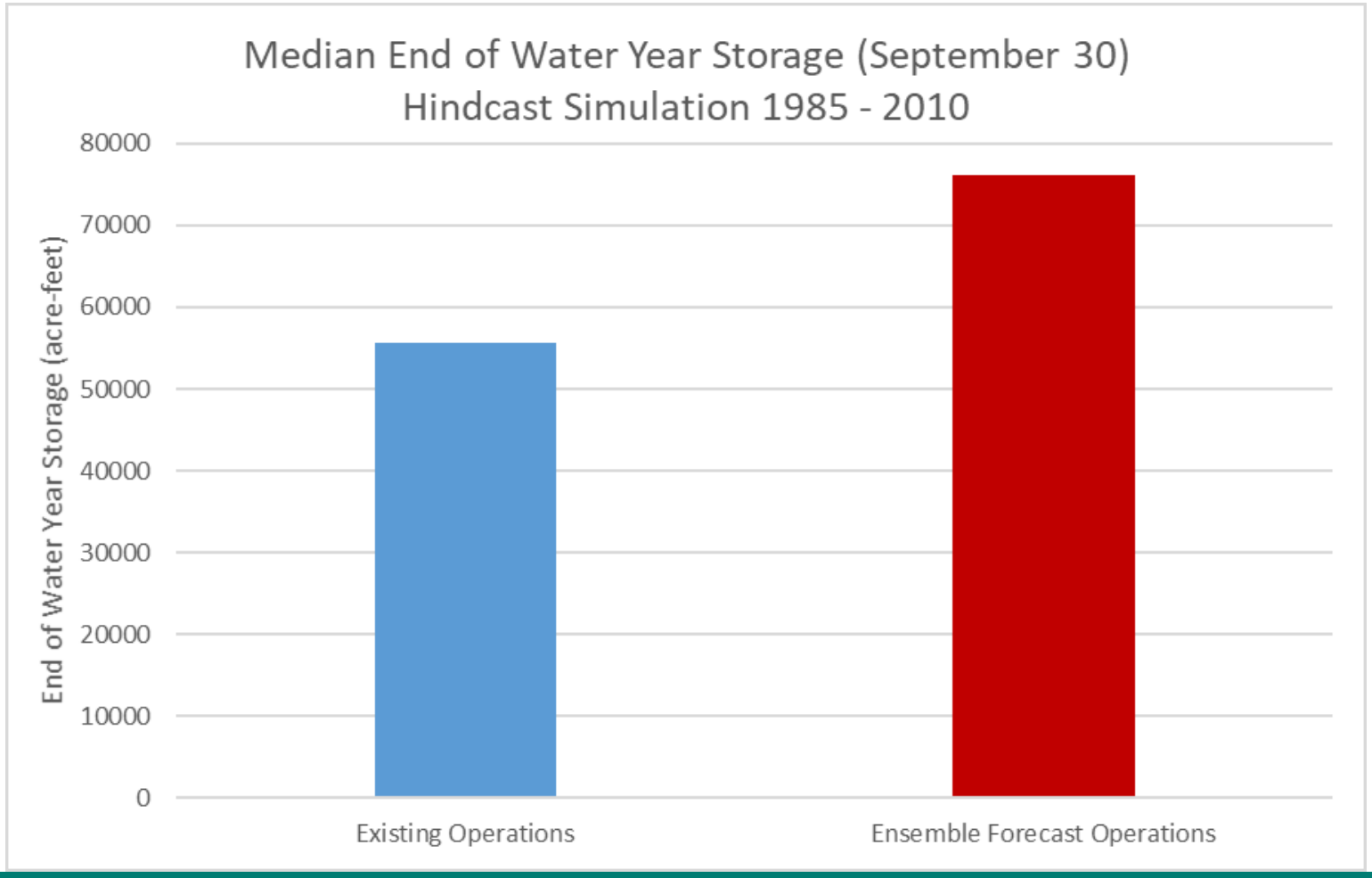
**Scripps CW3E** – AR analysis, monitoring enhancements, and quantified forecast skill requirements



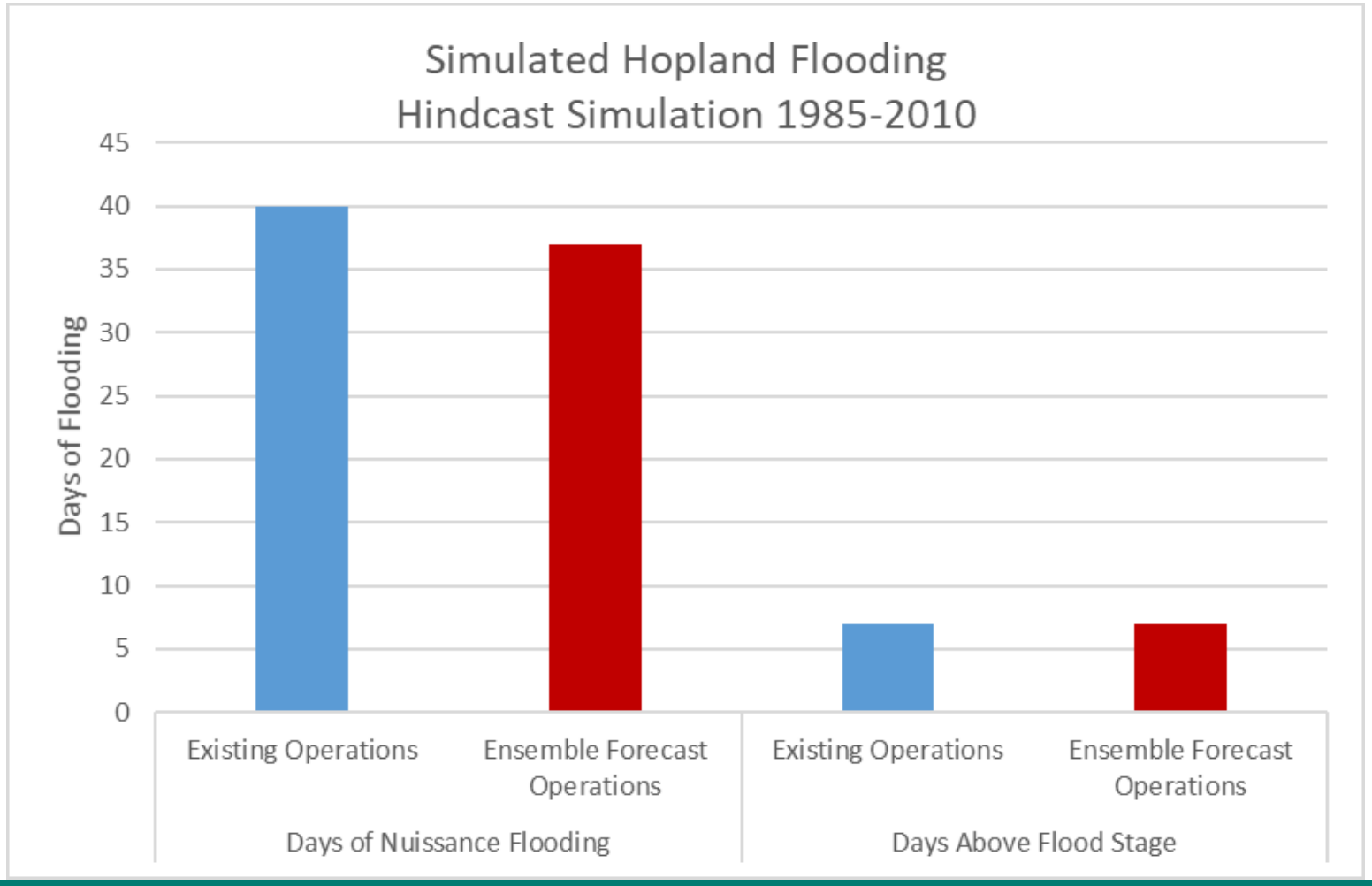
# Lake Mendocino Storage Hindcast Simulation 1985-2010



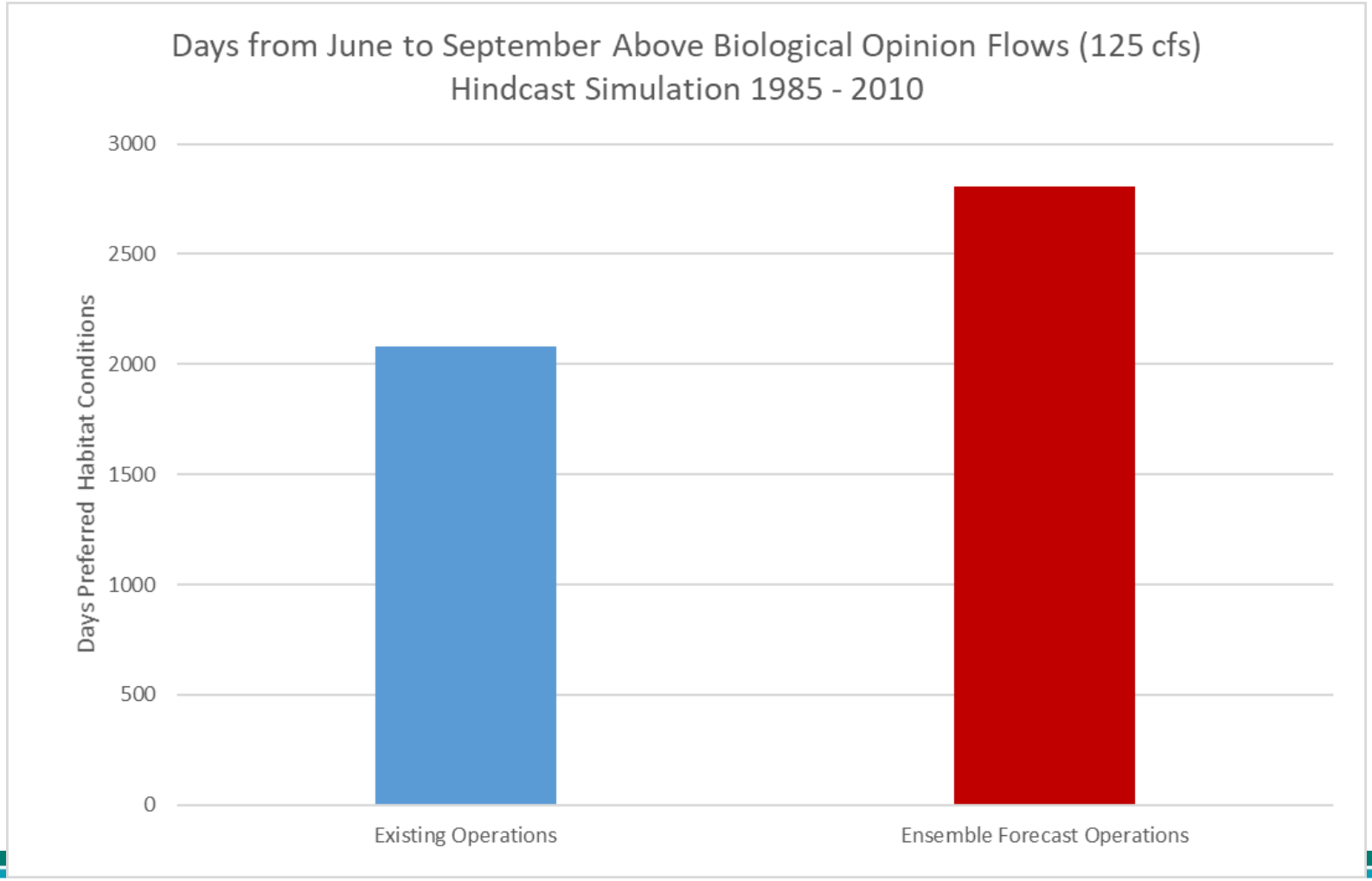
# Increased Water Supply
# Hindcast Simulation 1985-2010



# Improved Food Risk Management Hindcast Simulation 1985-2010



# Improved Habitat Conditions Hindcast Simulation 1985-2010



# 2017 Virtual FIRO Operations

**Actual Operations** - In compliance with rule curve

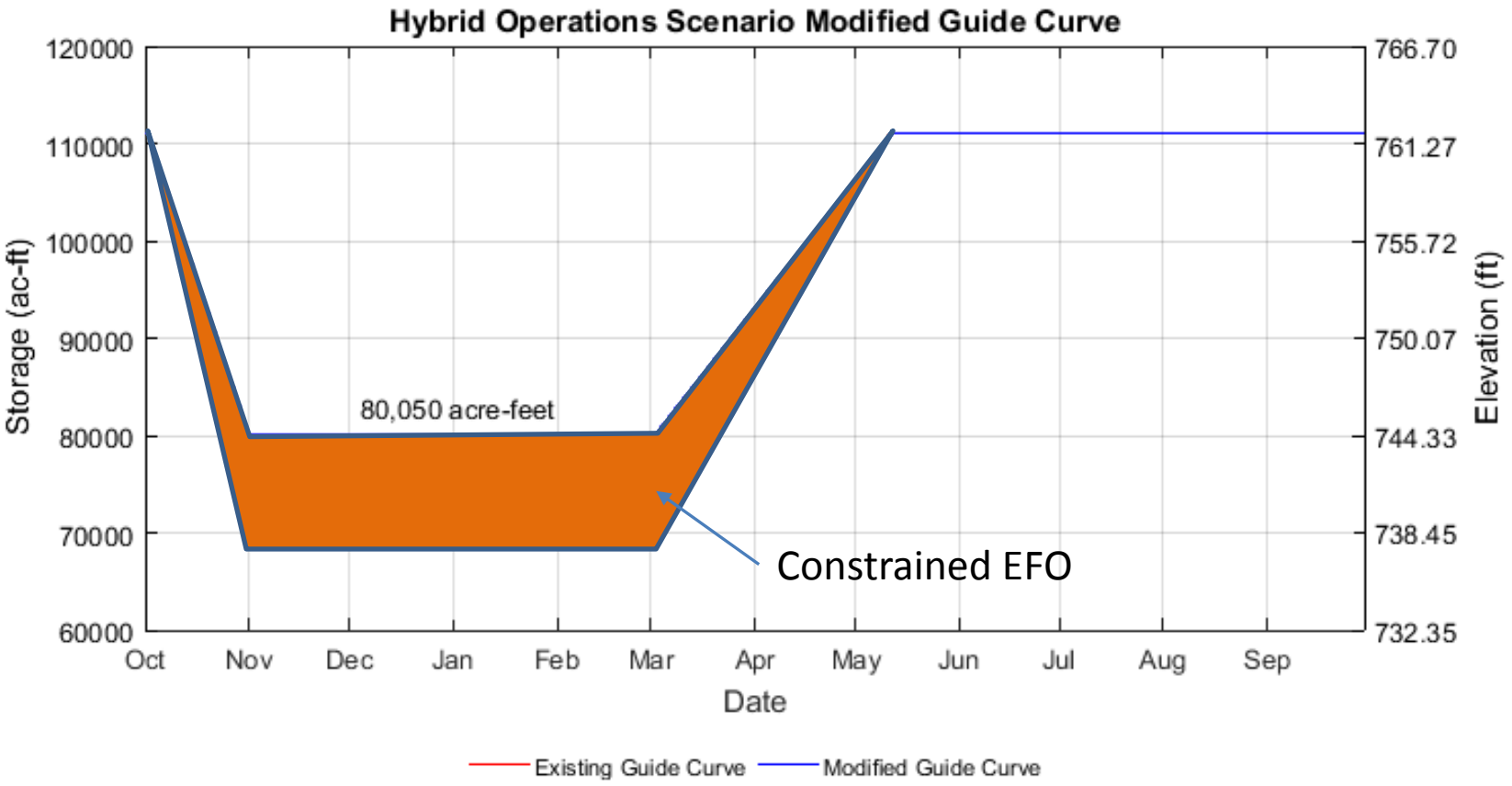
**Virtual Ensemble Forecast Operations (EFO)**

- No Rule Curve
- Operations by FIRO based on 60-member ensemble forecasts of reservoir inflows from CNRFC (NWS)

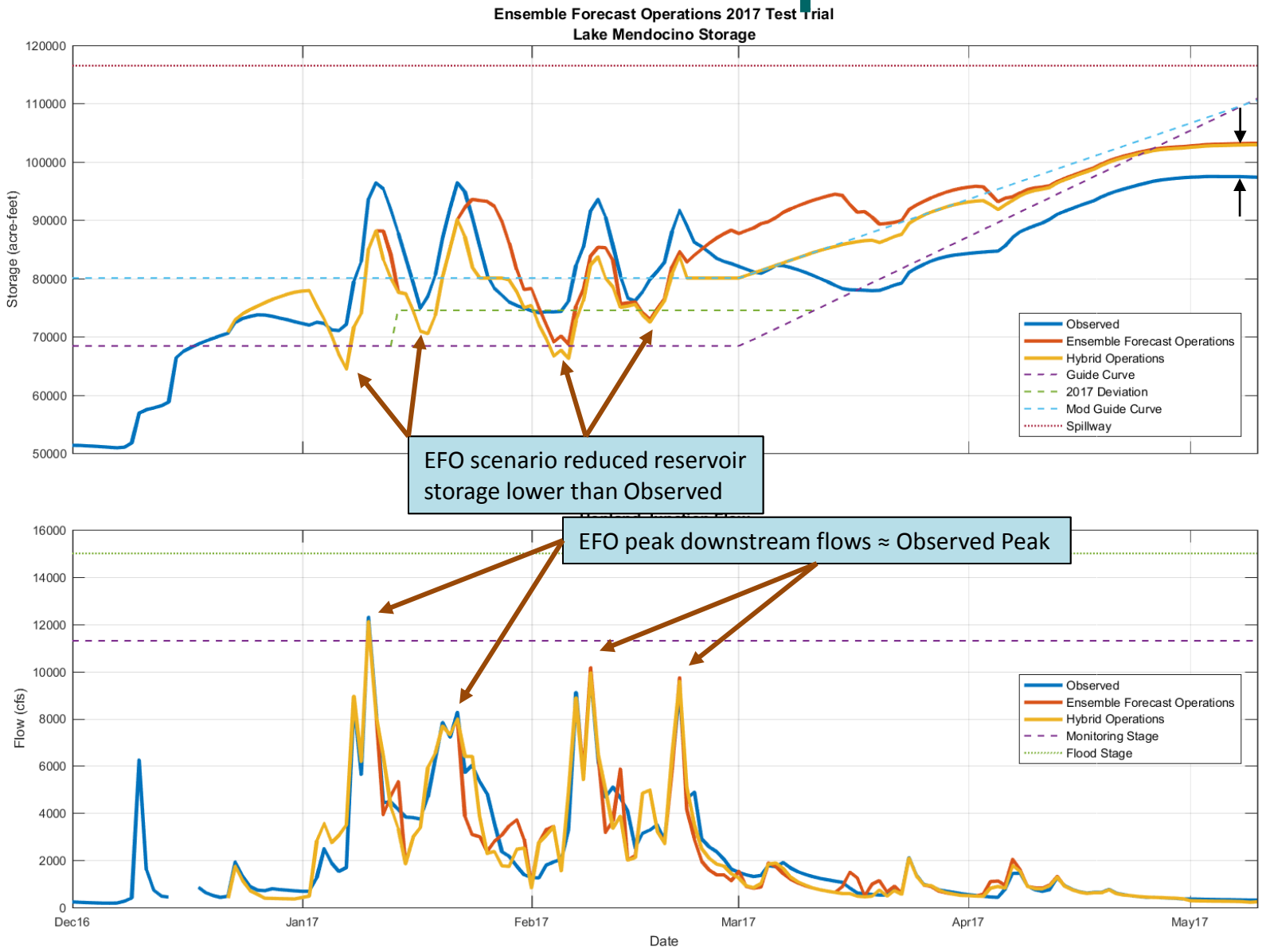
**Virtual Hybrid Operations**

- Combination of Rule Curve & FIRO
- Zone or band of storage which is operated by FIRO using ensemble forecasts are used to inform operations
- When storage outside of FIRO zone/band, operations by rule curve

# Virtual Hybrid Operations Scenario



# 2017 Virtual FIRO Operations

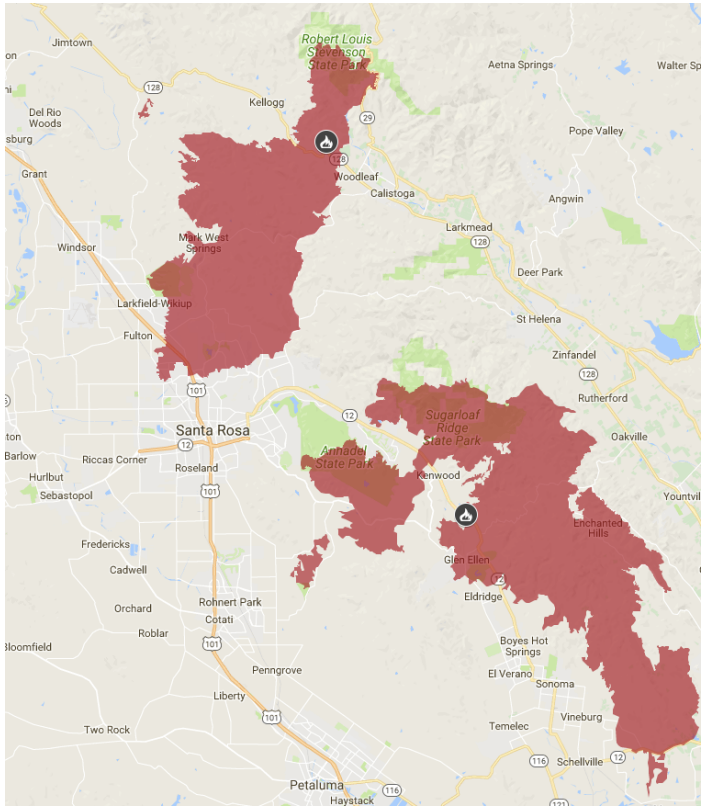


# FIRO Final Viability Assessment Activities

- Interim Operations Team
  - Major deviation request for WY2018/19
  - Develop Decision Support System (DSS) to augment water management tool set
- Technical Studies Team
  - Investigate numerous issues identified in PVA
- Scientific Research Team
  - Develop advanced weather forecasting capability for West Coast (West-WRF)

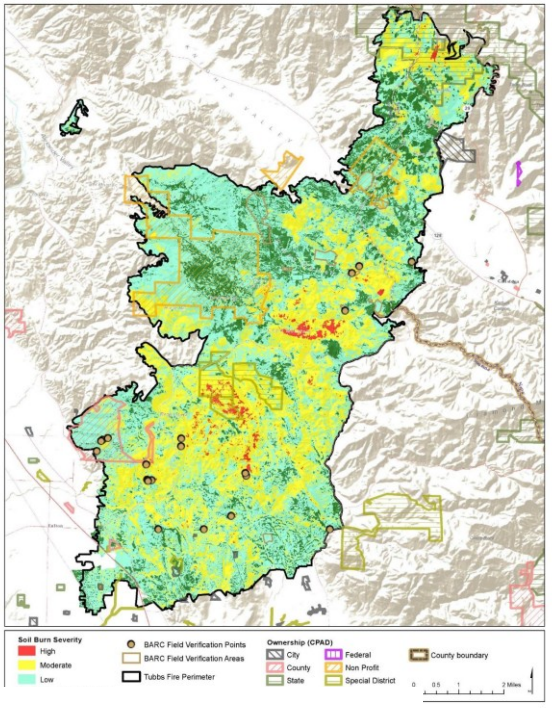
# Risks Posed by AR's to Areas Burned by North Bay Wildfires of 2017

- Tubbs Fire
  - 36,807 Acres
  - 22 Deaths
  - 5,643 Structures Destroyed
- Nuns Fire
  - 56,556 Acres
  - 3 Deaths
  - 1,355 Structures Destroyed
- 37 Fire
  - 1,660 Acres
  - 25 Structures Destroyed

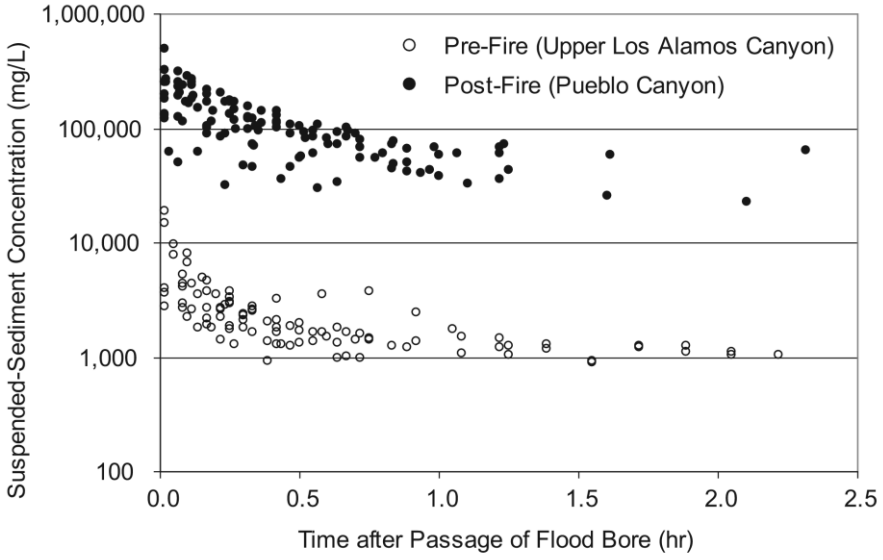



# Increased Flood Risk

- Impacts of fire include ground cover & canopy reduction, burned soils, & hydrophobic conditions
- Reduce infiltration rates & increase sediment yield
- Potential for increase in floods & debris flows




B

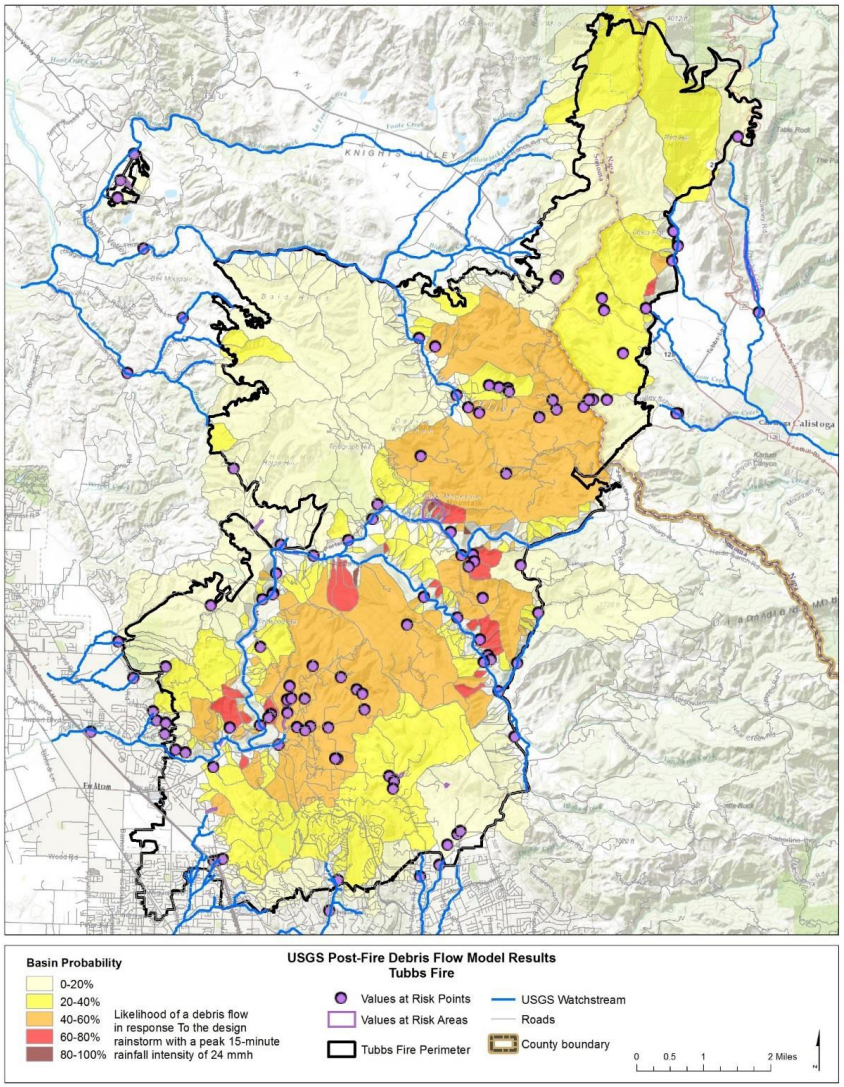


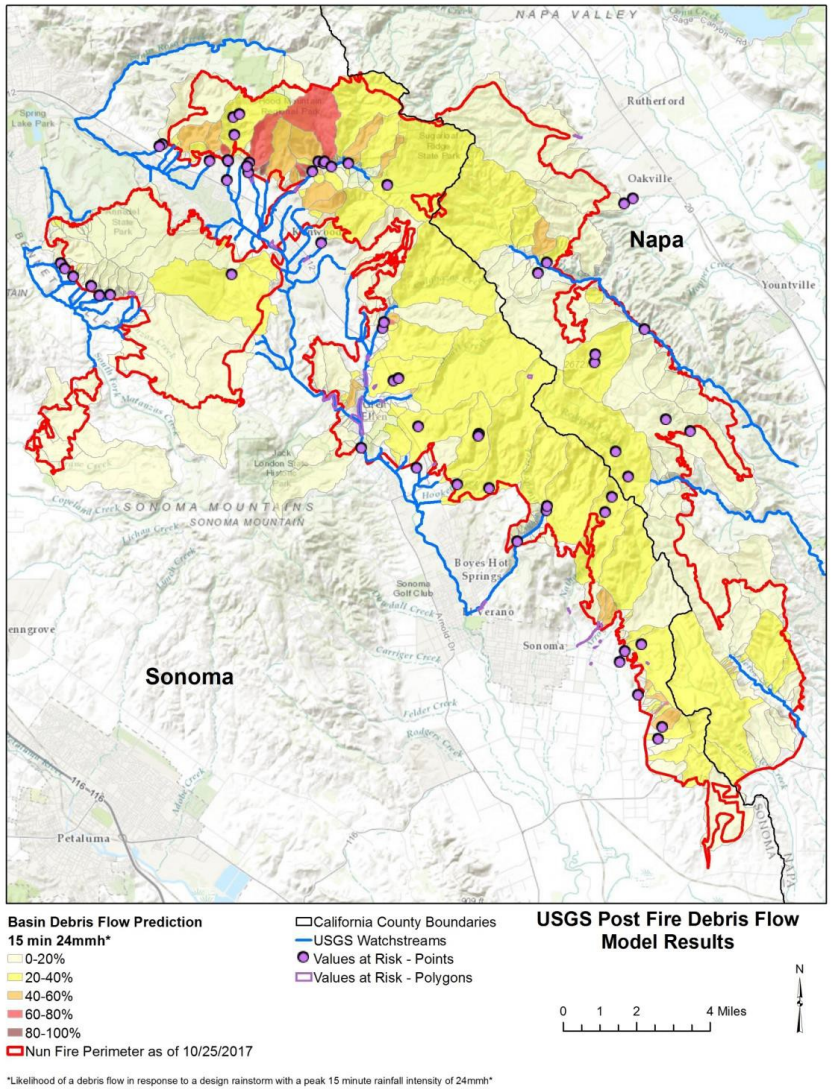
# Increased Flood Risk in Tubbs Area

| Pour Point / Watershed Name | Pre Fire Discharge | Post Fire Discharge | 10 Yr Increase | Pour Point / Watershed Name | Pre Fire Discharge | Post Fire Discharge | 10 Yr Increase |
|---|---|---|---|---|---|---|---|
| | Q10 (cfs) | Q10 (cfs) | % Increase | | Q10 (cfs) | Q10 (cfs) | % Increase |
| Kimball Reservoir Inlet | 317 | 356 | 12 | Leslie Creek | 710 | 880 | 24 |
| Blossom Creek at Foothill Blvd | 770 | 918 | 19 | Lower Rincon Creek | 1,113 | 1368 | 23 |
| Garnett Creek at Hwy 29 | 1,188 | 1211 | 2 | Porter Creek | 1,697 | 2009 | 18 |
| Calistoga WWTF | 5,433 | 5786 | 6 | Upper Mark West Creek | 3,475 | 3798 | 9 |
| Paradise Reservoir | 96 | 113 | 17 | Mark West Springs | 6,218 | 7486 | 20 |
| Cloverleaf Reservoir | 186 | 234 | 26 | Lower Mark West Creek | 7,221 | 9025 | 25 |
| Linda | 328 | 554 | 69 | North Branch Franz Creek | 335 | 462 | 38 |
| Brush Creek | 390 | 434 | 11 | Martin Creek Reservoir | 351 | 360 | 3 |
| Mill Creek at Cresta Road | 456 | 762 | 67 | Yellowjacket Creek | 413 | 557 | 35 |
| Piner Creek Reservoir | 466 | 576 | 24 | Middle Branch Franz Creek | 516 | 786 | 52 |
| Shilo | 503 | 543 | 8 | Bidwell Creek | 630 | 646 | 3 |
| Riebli | 505 | 787 | 56 | South Branch Franz Creek | 721 | 1130 | 57 |
| Humbug Creek | 618 | 694 | 12 | Franz Creek at Franz Valley Road | 1,948 | 2681 | 38 |
| Upper Rincon Creek | 624 | 837 | 34 | Lower Franz Creek | 3,631 | 4342 | 20 |

- For reference, Q100 is only 61% > Q10 at St. Helena gage

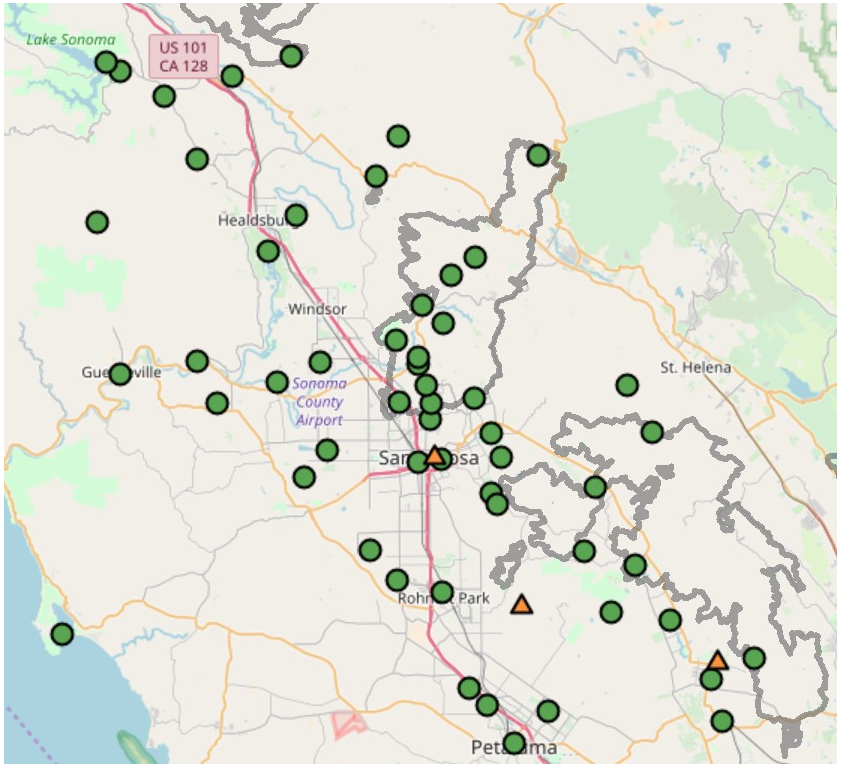
# Debris Flow and Watch Stream Maps



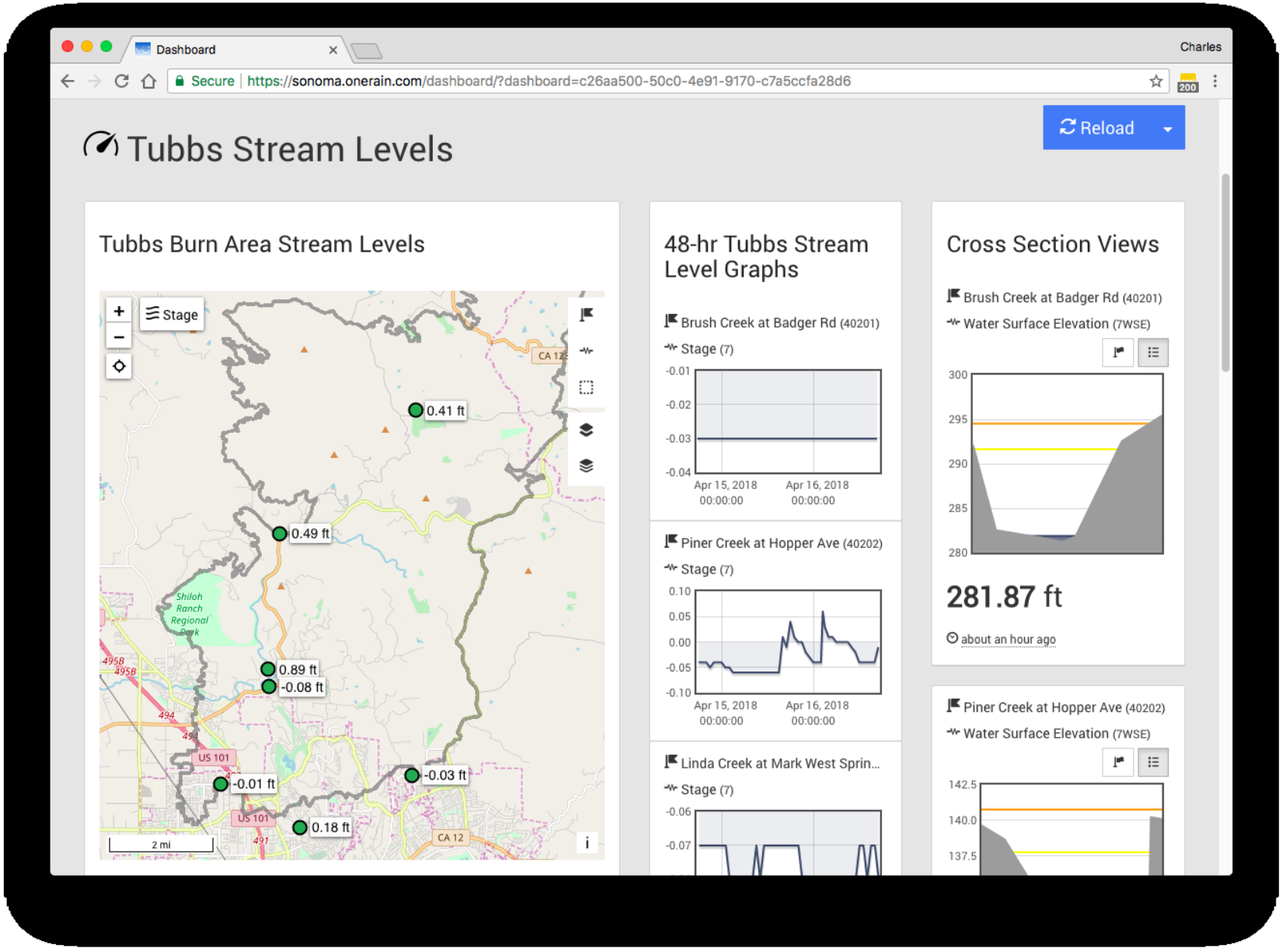



# Sonoma County Water Agency ALERT2 Network - Response to 2017 Wildfires

- 25 ALERT2 gage locations
  - 13 Rain / Stage
  - 12 Rain Only
  - 4 Soil Moisture
- System operational Feb 28th
- 2.0+ inches rain on Feb 29th
- Over 10 Inches rain since system implemented
- https://Sonoma.onerain.com
- Temporary X-Band radar 2018
- Planned Permanent radar from AQPI



# Flood Warning Software



# Summary

- Atmospheric Rivers: Our region's extreme weather events
- AR's produce almost 50% average annual rain in a few days
- ARs cause Russian River flashy hydrology: Droughts/Floods
- Water managers need to plan for AR events to ensure reliable operations and protect public safety
- FIRO shows promise in leveraging current (and future) forecasting skill & new technology to improve reservoir functionality in areas exhibiting variable precipitation
- ARs pose significant hazards in & below burned areas: Improved observational capacity & forecasting are essential to protect public safety and property